

NON-PUBLIC?: N  
ACCESSION #: 8905030409  
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Point Beach Nuclear Plant PAGE: 1 OF 7

DOCKET NUMBER: 05000301

TITLE: Fire System Actuation Induced 2X01C Fault and Unit Trip  
EVENT DATE: 03/29/89 LER #: 89-002-00 REPORT DATE: 04/28/89

OPERATING MODE: N POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR  
SECTION  
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:  
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Vice President - Nuclear Power TELEPHONE: 414-221-2811

COMPONENT FAILURE DESCRIPTION:  
CAUSE: C SYSTEM: EL COMPONENT: XFMR MANUFACTURER: W120  
X FK 62 W120

REPORTABLE TO NPRDS: Y  
N

SUPPLEMENTAL REPORT EXPECTED: NO

#### ABSTRACT:

On March 29, 1989, at 0843 hours, Unit 2 experienced a main step-up transformer lockout main generator breaker trip and concurrent turbine and reactor trips. The unit had been operating at 100% power. The lockout occurred shortly after the spurious actuation of the Unit 2 X01C phase fire deluge spray system. The deluge spray apparently induced a flashover from the transformer to ground, which was detected by transformer differential protective relays. The spray system actuated while troubleshooting a wiring problem discovered during modification work which replaced the transformer deluge heat actuation devices with new electronic detectors.

The emergency diesels automatically started because of bus undervoltage. The undervoltage condition was the result of the premature actuation of the generator stuck breaker protection relay, which isolated a Unit 1 bus section

cross-connection. The voltage decreased on the remaining transmission line to Unit 2 due to a maintenance outage at a nearby plant and the line losses associated with transmission from other distant supplies.

An Unusual Event was declared at 0854 hours. The event was terminated at 1205 hours. Repairs were effected and the unit returned to service on April 2.

END OF ABSTRACT

TEXT PAGE 2 OF 7  
EVENT DESCRIPTION

On the morning of March 29, 1989, plant maintenance electricians were completing post-modification tests on the Unit 2 unit auxiliary transformer (2X02) fire protection system control panel. The modification was being implemented to replace the outdated heat-actuated devices (HADs) with new electronic detectors. The testing was being conducted per a Special Maintenance Procedure (SMP 908) specifically written for the modification.

The procedure for checkout and testing called for the signal to the deluge valve release solenoid to be defeated. The signal is defeated by sliding the "city box" switch to "OFF". The zone detection module is then inserted into the card slot. The module had been removed during installation to reduce the possibility of accidental deluge actuation. After checkout of the remote release circuit, the signal to release the solenoid would be restored. Only one deluge system was isolated at a time to minimize the fire protection unavailability for any piece of equipment.

The remote release circuits for 2X01A, 2X01B, and 2X01C had already been checked and the systems returned to normal operation. All wiring, checkout, and testing steps of the controlling SMP (908) had been completed with the exception of the testing of the circuit for 2-FP-3700, deluge valve for 2X02 transformer.

An unexpected response was received during the tests of the circuit for deluge valve 2-FP-3700 actuation. Electricians began troubleshooting at terminal box 2-TB69 because an earlier step in the SMP made wiring changes in this box. The changes had been completed as designed.

At this point, the electricians suspected their test equipment had malfunctioned. A decision was made to cross-check the circuit for the 2X01C main step-up transformer deluge valve 2-FP-3501, which had proven good earlier in the procedure. The multimeter was inadvertently selected for resistance instead of voltage, and the resulting short circuit was sufficient to actuate the 2X01C deluge circuit.

A 2X01C transformer suppression actuation alarm was received in the main control

room, and an auxiliary operator was immediately dispatched to investigate. The operator witnessed no fire and returned to the turbine building. Before the transformer fire header could be manually isolated, transformer differential protective relays sensed a flashover of the transformer to ground.

TEXT PAGE 3 OF 7

This caused a main step-up transformer lockout (2-86/X01), which caused a main generator lockout (2-86/TG01), resulting in a main generator breaker trip and subsequent turbine and reactor trips. The spray actuation to lockout signal time was estimated to be approximately 55 seconds. The time of the lockout signal was 0843 hours. After the trip, operators observed apparent transformer high voltage bushing damage. An Unusual Event was declared per Emergency Plan procedures.

The fast bus transfer of the non-vital 4160 V bus loads (A01 and A02) to the transfer buses (A03 and A04) occurred as expected. However, the "generator breaker trip failure relay" (62-142) actuated prematurely. The relay is designed to isolate generator output from the 345 kV grid at switchyard bus section 4, should the generator breaker fail to trip during a fault condition. Bus section 4 isolated per the relay signal. The isolation of this bus section left a single 345 kV supply (Line 151) to the Unit 2 auxiliary loads. Since loads at Point Beach are at the end of the line when the unit is not generating, significant line losses become evident. Voltage dips to 3700 volts on the normal 4160 v system were experienced. The 480 V busses supplied from the degraded 4160 V busses were operating at 93.5% of the 480 V motor rating. Consequently, vital bus undervoltage protection actuated, and the emergency diesels started and energized the Unit 2 vital busses.

The Unit 2 electrical undervoltage condition caused the loss of three non-vital motor control centers (2B31, B33, B32), the charging pumps, the cavity cooling fans, containment accident fans, all four battery chargers, K2A instrument air compressor, and both service air compressors. Coincidentally, instrument air compressor K2B had been tagged out of service for maintenance. The instrument air header pressure decreased to 64 psig per the control room indication. Operators restarted a service air compressor and quickly cross-connected service air to instrument air to restore normal instrument air header pressure.

Unit 2 remained in this condition for 1.5 hours while technicians investigated the cause of the bus section 4 isolation. The "Unusual Event" was terminated at 1205 hours, after the switchyard 345 kV system was restored to normal lineup (i.e., bus section 4 re-energized and the emergency diesel returned to automatic standby status.)

The 2X01C transformer bushing, as well as relay 62-142, was replaced. The transformer entered a mandatory conditioning period while primary and secondary

system chemistry was stabilized. The unit was restored to operation on April 2, 1989.

TEXT PAGE 4 OF 7

## SYSTEM AND EQUIPMENT DESCRIPTION

Point Beach is a two-unit pressurized water reactor plant. Both units are connected to the 345 kV distribution grid by means of a five-section bus that serves, or is supplied by, four separate 345 kV transmission lines. The five-section bus is fed by the 19 kV output from each unit's main generator via their respective X01A, B, and C phase main step-up transformers. The station auxiliary loads are supplied from either the unit auxiliary transformers (X02s) or from the high- and low-voltage station auxiliary transformers (X03s and X04s). Nearby Kewaunee Nuclear Plant, which also feeds the grid, was off line during the event for refueling and maintenance work.

Main step-up transformer 2X01C is a single-phase, Class FOA, 19 kV to 345 kV, shell form-outside assembly transformer. It was manufactured by Westinghouse and was placed into service during November 1986.

The main step-up transformer fire suppression system utilizes a 1 1/4" pipe ring header with controls and valves manufactured by "Adelphia Automatic Sprinkler Systems." Adelphia also manufactured the open head model "starguard" nozzles. The header and spray nozzles are suspended approximately 20" to 24" above the transformer and are designed to concentrate the spray on the transformer body. The spray medium is fresh water from Lake Michigan.

The fire system heat actuation devices (HADs) were being replaced by electronic detectors. The former detectors were becoming outdated and spare parts are in short supply. The old system also contained mercury and had a history of spurious actuation on hot, sunny days.

Among other protection circuits, the main generator can isolate from the 345 kV grid via a Westinghouse Model SBF-1 relay signal. This relay senses a main generator breaker failure-to-open and isolates the associated bus section 4 within 7.2 cycles.

## CAUSES, EQUIPMENT RESPONSES, AND CORRECTIVE ACTIONS

The unexpected response received by electricians during the performance of SMP 908 was discovered to be a wiring error in terminal box 2-TB69. One of the terminations of 2X02 unit auxiliary transformer fire suppression circuit (2-FP-3700) was not in accordance with as-constructed drawings. The wiring error was corrected.

The reason for the 2X01C phase transformer flashover after the deluge spray actuation is not definitely known. The transformer is not shielded from the elements in any manner. As indicated earlier in the report, inadvertent spray actuations have occurred in the past. Plant operations instruction OI-35 directs the use of the spray deluge system in a modulated manner to aid in cooling of the transformers during peak operation summer months. The instruction properly cautions operators to ensure the insulators stay dry and provides cautions regarding potential oil cooler fan and pump faults. Prior to this event, neither rainy weather, the spurious actuations, nor the modulated operation of the transformer spray deluge system had produced a transformer flashover-to-ground fault. Prior to restart, the orientation of the eight spray nozzles on 2X01C near the transformer bushing was measured and recorded. The nozzles on the sides of the transformer (six nozzles) were directed on an average 30 to 35 degrees below horizontal. The two nozzles at the cooler end discharged downward at 50 degrees below horizontal.

The spray pattern of the deluge nozzles was checked and recorded on the 2X01A, B, and C transformers and on the 2X02 transformer. The information was recorded using video and still cameras. The spray pattern of the deluge nozzles was also checked and recorded for 1X01A, B, and C and 1X02 transformers during Unit 1's current refueling outage. Analyses indicated the nozzles on the 2X01C were directed higher than on the other transformers, but there was no indication of direct spray impingement of the bushing. However, there was ricochet and mist rising from the spray impingement which could have induced the flashover under different environmental conditions related to wind speed and direction.

The fire water conductivity was tested and found to be well within EPRI recommendations for spray deluge systems over transformers. Conductivity was measured at approximately 300 micromohs/cm versus the EPRI spec of 1400 micromohs/cm.

The transformer bushing was removed and inspected for potential indications of material defects which could have spurred the flashover. None could be found. The transformer bushing has been sent to the manufacturer for further tests. Testing of the transformer internals identified no damage. The bushing was replaced with a spare. The transformer oil was filtered, and any combustible gases were removed from the internals. The lightning arrester corona, which suffered arcing damage, was repaired.

In summary, the results of the inspections and testing on the 2X02C main step-up transformer were inconclusive. While evidence does not fully support the argument, the timing of the event indicates an induced transformer flashover to ground due to deluge spray actuation as the cause of the event.

TEXT PAGE 6 OF 7

Another investigation focused on the cause of the premature actuation of the "generator breaker trip failure relay" (62-142). This relay had been in service for approximately three years. During the event, the relay had timed out in five cycles versus 7.2 cycles per design. As a consequence, 345 kV bus section 4 isolated. Had the bus section remained closed, undervoltages would not have been sensed, and safeguards actuations (emergency diesels) would not have initiated. The relay was removed and bench tested. No anomalies were discovered. Relay 62-142 was replaced as a conservative measure.

A final investigation concentrated on the reasons for the difficulty with re-establishing pressure to the instrument air system. Instrument air a  
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service air are common to both units; each air system is supplied by two compressors. During the event, one instrument air compressor (K2B) was out of service for maintenance. When bus section 4 isolated, voltage dips to 3700 volts on a normal 4160 volt system were experienced. This resulted in the tripping of certain loads on both units, including the operating air compressors. The decreasing air header pressure was noted by operators. The two air supply systems were cross-connected. Attempts to start the K3B service air compressor from the control room were unsuccessful. However, operators were able to start the compressor in the compressor room. Maintenance investigations concluded that, under the degraded voltage conditions that existed during this event, the master control relay could not actuate electrically. In effect, the circuitry did not malfunction, but performed as expected for the conditions at that time.

## GENERAL IMPLICATIONS

There have been no generic implications identified at this time. if it is determined that there were material or design defects with the transformer or its bushing, Unit 1 transformer 1X01A could also be affected, since it is the same type as 2X01C. All other transformers identified in the text of this report were manufactured by another company.

TEXT PAGE 7 OF 7

## REPORTABILITY

This Licensee Event Report is provided pursuant to 10 CFR 50.73(a)(2)(iv), "Any event or condition that resulted in the manual or automatic actuation of any engineered safety feature, including the reactor protection system." An Unusual Event was declared at 0854 hours on March 29, 1989, according to Point Beach Emergency Plan procedures. The NRC, along with state and county emergency government, notifications were completed at 0904 hours. The event was

terminated at 1205 hours after a post-trip review and the re-establishment of normal AC power supplies to Unit 2 loads.

#### SAFETY ASSESSMENT

The health and safety of the general public, as well as plant employees, was not affected during this event. The Point Beach Nuclear Plant Final Safety Analysis Report discusses a loss of external electrical load as one of its analyzed accidents. In that analysis, the assumed initial power level is 102% and no credit is taken for the turbine trip of the reactor.

#### SIMILAR OCCURRENCES

Investigations indicate that there has not been a previous transformer flashover to ground induced by fire deluge spray at Point Beach Nuclear Plant.

There were two other occurrences of a loss of off-site loads. One event was initiated by the failure of a station class lightning arrester in the switchyard immediately outside the plant (see LER 301-85-005). The other event was initiated by a lightning strike near 2X01B phase transformer (see LER 301-87-002).

ATTACHMENT 1 TO 8905030409 PAGE 1 OF 1

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VPNPD-89-259 10 CFR 50.73  
NRC-89-053

April 28, 1989

U. S. NUCLEAR REGULATORY COMMISSION  
Document Control Desk  
Mail Station P1-137  
Washington, D.C. 20555

Gentlemen:

DOCKET 50-301  
LICENSE EVENT REPORT 89-002-00  
REACTOR TRIP INDUCED BY FIRE SYSTEM  
CAUSED TRANSFORMER FAULT  
POINT BEACH NUCLEAR PLANT, UNIT 2

Enclosed is Licensee Event Report 89-002-00 for Point Beach Nuclear Plant, Unit

2. This report is provided in accordance with 10 CFR 50.73(a)(2)(iv), "Any event or condition that resulted in the manual or automatic actuation of any engineered safety system including the reactor protection system."

This report describes a reactor trip. The trip was the result of a chain of expected events caused by a turbine trip which was the result of a transformer bushing fault caused by an inadvertent actuation of the transformer's fire protection system.

If you have any questions regarding this Licensee Event Report, please do not hesitate to contact us.

Very truly yours,

C. W. Fay  
Vice President  
Nuclear Power

Enclosure

Copies to NRC Regional Administrator, Region III  
NRC Resident Inspector

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